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VSE/ASD/0043-92/14RD

20-TON ROUGH TERRAIN CRANE

New Sources of Supply for Obsolete Secondary Items

Joseph A Lepri, Senior Project Engineer
Robert W. LaChance, Project Engineer

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31 May 1992

Final report for period 13 September 1991 through 31 May 1992

Approved for public release; distribution is unlimited

Prepared for:

U.S. Army Belvoir Research, Development and Engineering Center
Engineering Data Management Division (STRBE-TSX)
Fort Belvoir, VA 22060-5606

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

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Some secondary item assemblies for the Army's 20-Ton Rough Terrain (RT) Crane Program have been tentatively identified as being obsolete because they appear to be no longer obtainable. New, competitive sources of supply for these items, used with the M2380, M2385, and M320 RT Cranes, are needed to keep these cranes operable. VSE Corporation reviewed 18 specific stock listed items and recommended that 10 replacement items be obtained and tested, 1 item should continue to be manufactured, and 7 items required no further action as they are still available.

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PREFACE AND ACKNOWLEDGEMENTS

This report was prepared under the authority of Task Order No. 0043 to U.S. Army Belvoir Research, Development and Engineering Center (Belvoir) Contract No. DAAK70-90-D-0001. Contract No. DAAK70-90-D-0001 requires VSE Corporation to provide engineering and technical support for a wide range of programs and projects being performed at Belvoir. Task Order No. 0043 is concerned with performance of an engineering program to reduce cost of replenishment parts by developing new, competitive sources of supply for 20-Ton Rough Terrain Crane obsolete secondary items.

The authors of this report wish to acknowledge the valuable contributions and guidance provided by Ms. Cathy B. Gardner of Belvoir's Production Engineering Team (Engineering Data Management Division [STRBE-TSX]), and Mr. Edward E. Rudy of Belvoir's Construction, Rails and Diving Team (Marine and Mechanical Equipment Division [STRBE-FMT]).



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20-TON ROUGH TERRAIN CRANE

New Sources of Supply for Obsolete Secondary Items

1. SUMMARY

Some secondary item assemblies needed as spare and/or repair parts, for the Army's 20-Ton Rough Terrain (RT) Crane Program, have been tentatively identified as being obsolete because they appear to be no longer obtainable. New competitive sources of supply for these items, used with the M2380, M2385, and M320 RT Cranes, are needed to keep these cranes operable.

Consequently, the U.S. Army Belvoir Research, Development and Engineering Center (Belvoir), in support of the Army's Tank-Automotive Command (TACOM), tasked VSE to review 18 specific stock listed items and locate competitive, alternate sources of supply as applicable. Specific recommendations resulting from the review are categorized in general terms as follows:

- o Obtain/test 10 potential alternate items (compatibility or interchangeability).
- o Continue to manufacture one item (drawing available, item not obsolete).
- o Take no further action on seven items (items found to be still available).

One overall conclusion and two recommendations address updating Technical Data Packages (TDPs) and provisioning documentation.

2. INTRODUCTION

2.1 Subject. The M2380, M2385, and M320 RT Cranes support the Army's 20-Ton Rough Terrain (RT) Crane Program. Basically, these cranes consist of a Crane Carrier (Transporter) and a Crane Assembly (Upper Works).

2.2 Purpose of Report. This report documents the investigation and recommendations concerning 18 specified 20-Ton Rough Terrain (RT) Crane Program spare and/or repair parts tentatively identified as obsolete and needing replacement.

2.3 Scope of Report. This report focuses upon specific secondary items used to support TACOM's 20-Ton RT Program. Each item discussed has a National Stock Number (NSN).

2.4 Development of Report. The 18 secondary items discussed in this report are categorized according to a specific crane model or as a common use item. Technical recommendations are at the end of each item discussed. The final section of this report

contains one conclusion and two recommendations concerning updating TACOM's technical and provisioning data.

2.5 Reference to Related Work. Earlier prototype efforts for the 20-Ton R.T Crane were completed by VSE under Task Order Nos. 001 and 002 to Belvoir Contract No. DAAK70-78-D-0080. These efforts included the retrofit of the Cummins Model V903 engine into the M2385 Crane Carrier, and preparation of the drawing package used to procure and build the Model M320 RT Crane.

2.6 Disposition Instructions. Destroy this report when no longer needed. Do not return it to the originator.

3. METHODS, ASSUMPTIONS, AND PROCEDURES

The methods and procedures used to complete this task order were inline with Belvoir's requirements to collect and evaluate data, perform technical and economic evaluations, and provide supply feedback.

As directed by task order, VSE obtained data from Government procurement history files, Master Cross-Reference List (MCRL), Haystack and GIDEP (Government-Industry Data Exchange Program). Frequent contact with applicable industrial sources was also made to gather and analyze applicable data.

No assumptions were necessary for use in this task order.

4. RESULTS AND DISCUSSION

4.1 General. Belvoir, in coordination with TACOM, identified 18 candidate obsolete secondary items needing new competitive sources of supply for the 20-Ton Crane Program. VSE was required to collect, evaluate, and analyze data to determine and locate alternate sources of supply that can produce substitute competitive end items. The 18 items addressed by VSE, and categorized according to major end item, are:

- o M2380 Crane Unique Parts

NSN 2815-00-943-9271; Diesel Engine, Crane Carrier.

NSN 4820-00-945-5348; Hydraulic Valve, Crane Carrier Rear Steering Mode Selector.

NSN 2520-00-951-4433; Torque Converter, Crane Carrier.

NSN 2815-00-939-7464; Oil Pump Assembly, Crane Carrier Engine.

- o M2385 Crane Unique Parts

NSN 2815-00-249-4201; Diesel Engine, Crane Carrier.

NSN 2990-00-239-4888; Heat Shield, Muffler, Crane Carrier Engine.

- o M320 RT Crane Unique Parts

NSN 2815-01-056-5393; Diesel Engine, Crane Upper Works (crane section).

- o M2380 and M2385 Crane Common Parts

NSN 2815-00-943-6417; Diesel Engine, Crane Upper Works.

NSN 2815-00-947-8283; Crankshaft Assembly, Crane Carrier Engines.

NSN 4310-00-410-5557; Air Compressor, Model M2385 Crane Carrier Engine.

- o M2385 and M320 RT Crane Common Parts

NSN 2910-00-438-1487; Fuel Tank, Crane Carrier Engines.

NSN 2520-00-404-2713; Torque Converter, Crane Carriers.

NSN 2520-00-404-2693; Transmission.

NSN 4320-00-404-2708; Hydraulic Motor, Crane Carriers.

NSN 2590-00-245-7673; Hydraulic Dozer Cylinder, Crane Carriers.

- o Parts Common To All Three Model Cranes

NSN 2520-00-404-2710; Front Axle, M2385 and M320 RT Crane Carriers.

NSN 4820-01-164-3415; Emergency Relay Valve, Crane Carriers.

NSN 4320-00-401-7133; Hydraulic Dual Pump, M2385 and M320 RT Crane Carriers.

The work effort resulted in the following generally categorized recommendations:

- o Obtain/test 10 potential alternate items (compatibility or interchangeability).
- o Continue to manufacture one item (drawing available, item not obsolete).
- o Take no further action on seven items (items found to be still available).

Discussions of the items investigated follow in sections 4.2 through 4.7.

4.2 M2380 Crane Unique Parts

4.2.1 NSN 2815-00-943-9271; Diesel Engine for the Model M2380 Crane Carrier (Dwg. 97403-13208E6546).

This Cummins Engine Company, Model V8-265-B1 (P/N 99045-44) engine was obsolete in the early 1970's, before the Model 320 RT Crane was built. It is a naturally aspirated V-8 engine, with a 785 Cubic Inch Displacement (CID) and 265 Brake Horsepower (BHP) at 2600 Revolutions Per Minute (RPM) intermittent load. The last Government procurement, during 1967, was for 14 engines costing \$4,620 each.

Possible replacement engines are:

- a) Cummins Model V903, naturally aspirated V-8, 903 CID, 265 BHP at 2600 RPM intermittent load, costing about \$26,000 each.
- b) Caterpillar Model 3208, turbocharged V-8, 636 CID, 265 BHP at 2600 RPM intermittent load, costing about \$14,000 each.
- c) Caterpillar Model 3116, turbocharged inline-six, 403 CID, 250 BHP at 2600 RPM intermittent load, with after cooler and air compressor, costing about \$7,000 each.

The power and size of the Caterpillar Model 3208 engine are similar to the old V-8 265 engine, and it has a good reputation for reliability. The Cummins Model V903 is overpowered for this application, must be derated, and is cost prohibitive. The Caterpillar Model 3116 engine: (1) is currently underpowered, but Caterpillar will soon try to uprate and test it at 265 BHP; (2) has been selected to power the New Family of Medium Tactical Vehicles (FMTV) consisting of 2½- and 5-Ton trucks, and; (3) will be available in the system for replacement and commonality of parts.

Installation of the selected new engine will require changing the engine mounting and connections to all of its support systems, as well as possible length changes to the output drive shafts. Development of a retrofit kit and a Modification Work Order (MWO) will be necessary.

The retrofit design, installation, test, and MWO development cost for a new engine is estimated to be \$103,000 (not including the new engine cost). This cost is valid only if the same engine is used for the Model 2385 Crane Carrier.

Recommendation:

- o Use the Caterpillar Model 3116 engine to replace the Cummins V-8 265-B1 engine.

4.2.2. NSN 4820-00-945-5348; Hydraulic Valve for the Model M2380 Crane Carrier's rear steering mode selection (Dwg. 97403-13208E6430) .

This Clark Equipment Company (P/N 137610) valve and the other hydraulic control valves and steering cylinders on the M2380 Carrier are no longer made by Clark.

Trinova Corporation/Vickers, Inc., makes a power steering valve Model SV20. Parts of this valve can be used with some new or reused parts of the old (137610) Clark valve to build a direct replacement for the old valve. The Vickers valve and its parts can also be used as a direct replacement or to build replacements for all of Clark's obsolete hydraulic valves presently used on all three crane models.

Development of detail and assembly drawings will be necessary for a direct replacement for NSN 4820-00-945-5348.

The base price of the Vickers SV20C-24BW8-11 valve is \$690. The modification, installation, test, and documentation effort for the replacement value is estimated to be \$25,000.

Recommendation:

- o Obtain the Vickers valve and test it to verify compatibility.

4.2.3 NSN 2520-00-951-4433; Torque Converter for the Model M2380 Crane carrier (Dwg. 97403-13208E6597).

This converter is still available from the manufacturer, Clark Equipment Company (Government Sales Office) P/N 282016.

A Twin Disc Inc. Model 8FLW-1450 converter can be used as an alternate. Installation will require plumbing changes to the three hydraulic pumps mounted on the converter. Development of a retrofit kit and Modification Work Order (MWO) will be necessary.

Recommendation:

- o Take no further action because the converter is still available from the Clark Equipment Company.

4.2.4 NSN 2815-00-939-7464; Oil Pump assembly which is an internal part of the Model M2380 Crane Carrier's engine.

The Crane Carrier engine is obsolete. However, its oil pump assembly (P/N BM76203) is still available from the manufacturer, Cummins Engine Company (Government Sales Office).

VSE believes it is not worth developing an alternate because the Cummins' oil pump assembly only costs \$1,083.00 each.

Recommendation:

- o Take no further action because the oil pump assembly is still available from the Cummins Engine Company.

4.3 M2385 Crane Unique Parts

4.3.1 NSN 2815-00-249-4201; Diesel Engine for the Model M2385 Crane Carrier (Dwg. 97403-13205E3870).

This Cummins Engine Company, Model V8-265-B1 (P/N 99047-30) was obsolete in the early 1970's, before the Model M320 RT Crane was built. As stated in section 4.2.1, the engine is a naturally aspirated V-8 with 785 CID and 265 BHP at 2600 RPM intermittent load. The last Government procurement, in 1970, was for two engines costing \$4,950 each.

VSE Corporation had previously retrofitted the Cummins Model V903 engine (Dwg. 97403-13219E0583) into the M2385 Crane Carrier, and prepared the drawing package used to procure and build the Model M320 RT Crane.

Possible replacement engines are the same as for the M2380 Crane (see section 4.2.1). The engine differences for the two models are:

- a) The exhaust is directed to the rear on the M2380 and forward on the M2385.
- b) The M2380 requires a belt driven pulley and air clutch to drive the cooling fan via a driveshaft up to the radiator.
- c) The M2385 requires a mount and a drive for a hydraulic pump.

The power and size of the Caterpillar Model 3208 are similar to the old engine, and it has a good reputation for reliability. The Cummins Model V903 is over powered for this application and must be derated, and it is also cost prohibitive. The Caterpillar Model 3116 is currently under powered at 250 BHP, but Caterpillar will try to uprate and test it at 265 BHP. The Model 3116 engine, selected to power the New Family of Medium Tactical

Vehicles (2 1/2 and 5 Ton Trucks), will be available in the system for replacement and commonality of parts.

Installation of the selected new engine will require changing the engine mounting and connections to all its support systems as well as possible length changes to output drive shaft. Development of a retrofit kit and MWO will be necessary.

The retrofit design, installation, test (see The Appendix), and MWO development cost for this engine is estimated to be \$136,000. If the Cummins V903 engine is used, a reduction in the estimated cost of \$42,000 is possible because of the existing design and drawing package.

Recommendation:

- o Use the Caterpillar Model 3116 engine to replace the Cummins V8-265-B1 engine.

4.3.2 NSN 2990-00-239-4888; Heat Shield for under the muffler of the Model M2385 Crane Carrier engine (Dwg. 97403-13205E3411-2). This heat shield is a part fabricated of sheet steel according to drawing 97403-13205E3411-2. As such, it is not an obsolete item.

Recommendation:

- o Fabricate replacement heat shields according to drawing 97403-13205E3411-2.

4.4 M320 RT Crane Unique Parts

4.4.1 NSN 2815-01-056-5393; Diesel Engine for the Model M320 RT Crane upper works (crane section).

This series 4-53, Model Number 50437200 engine is still available from Detroit Diesel Corporation. However, the model number has been changed from 50437200 to 50437000. To order the engine the NSN number must be specified along with the new model number.

Ordering by the model number (specified in the manuals and MCRL) is not sufficient to fully define all of the engine's options and accessories. This is a naturally aspirated, inline-4, 212 CID engine rated at 97 BHP at 2250 RPM intermittent load.

A Cummins Model 4BT3.9 engine can be used as an alternate. It is a turbocharged, inline-4, 239 CID engine rated at about 105 BHP at 2250 RPM. Installation will require changing the engine mounting and connections to all its support systems (air intake, exhaust, cooling, fuel and electrical). The manuals and MCRL will need changes to identify the revised model number and add the NSN number and description to all ordering documentation. Development of a retrofit kit and MWO will be necessary.

Recommendations:

- o Continue to use the Detroit Diesel Corporation Model Number 50437000 engine.
- o Update provisioning documentation to list the Detroit Diesel Model 50437000 engine and add an NSN.

4.5 M2380 and M2385 Crane Common Parts

4.5.1 NSN 2815-00-943-6417; Diesel Engine for the Models M2380 and M2385 Crane upper works.

This Cummins Model JN-6I engine (P/N 99045-43) has been obsolete for many years. It is a naturally aspirated inline-6, 401 CID engine, 100 BHP at 1800 RPM intermittent load. The last Government procurement, in 1968, was for 18 engines costing \$1,046 each.

Possible replacement engines are:

- a) Cummins Model 4BT3.9, turbocharged inline-4, 239 CID, 102 BHP at 1800 RPM intermittent load, costing about \$4,500 each.
- b) Caterpillar Model 3116, turbocharged inline-6, 403 CID, 119 BHP at 1800 RPM, without after cooler and air compressor, costing about \$5,600 each. This engine has been selected to power the New Family of Medium Tactical Vehicles (FMTV), and will be in the supply system for spares and provide commonality of parts.
- c) Ford Model BSD-666, naturally aspirated inline-6, 401 CID, 107 BHP at 1800 RPM, costing about \$6,000 each.
- d) John Deere Model 4045T, turbocharged inline-4, 276 CID, 103 BHP at 1800 intermittent load, costing about \$5,600 each.
- e) John Deere Model 6059D, naturally aspirated inline-6, 359 CID, 100 BHP at 1800 RPM intermittent load, costing about \$6,200 each.

Installation of the selected new engine will require changing the engine mounting and connections to all of its support systems. Development of a retrofit kit and MWO will be necessary. The crane should then be tested (see The Appendix).

Recommendation:

- o Use the Caterpillar Model 3116 engine to replace the Cummins Model JN-6I engine.

4.5.2. NSN 2815-00-947-8283; Crankshaft assembly which is an internal part of the Models M2380 and M2385 Crane Carrier engines.

This Cummins Engine Company crankshaft (P/N BM79405) and the V8-265 engines have been obsolete since the early 1970's. A worn crankshaft can be restored (rebuilt) by adding metal and then grinding the worn surface back to original dimensions. Companies specializing in crankshaft rebuilding are available. However, if the shaft is cracked or broken it must be replaced.

Cummins has said that they would remake the obsolete crankshaft if the Army ordered sufficient quantities. Cost for each would be around \$4,300.00 (about twice that of an equivalent current production shaft). A forging die must be made in order to reproduce this shaft. Cummins would not consider making new crankshafts without a significant number ordered to justify the tooling investment.

The replacement costs of a new crankshaft would justify replacement of the engine. This will make development of an alternate source very expensive.

Recommendations:

- o Rework worn engine crankshafts if at all possible.
- o Replace an engine if its crankshaft cannot be reworked.

4.5.3 NSN 4310-00-410-5557; Air compressor which is an integral part of the Model M2385 Crane Carrier engine.

This Cummins Engine Company compressor (P/N AR6307 and P/N 3018558) is no longer available. The last Government procurement, during 1987, was for 31 compressors costing \$828 each.

Both Bendix Heavy Vehicles Systems Division of Allied Signal, Inc., and Midland Heavy Duty Systems, Inc., were asked if they had a replacement compressor. Both companies make Original Equipment Manufacturer (OEM) and after market air compressors. However, neither company has one comparable to the Cummins compressor.

The air compressor (P/N 3018532), currently furnished with the Cummins V903 engine, will not fit directly into the obsolete Cummins (V8-265) Crane Carrier engine. However, our initial investigation indicates that the compressor mountings are the same and adaption is possible.

Installation of the Cummins (P/N 3018532) compressor will require compressor modifications, possible new parts and changes to the

water cooling lines, and connection of a compressed air line. Development of a retrofit kit and MWO will be necessary.

An alternative to this would be to have Cummins remake the obsolete air compressor assembly. This compressor, when used on the model M2380 engine, will not require the shaft's splined adapter for driving an engine mounted hydraulic pump.

A Model M2385 engine air compressor retrofit replacement could be procured, modified, installed, and the vehicle tested at VSE, as in (a) below. All of this work would be accomplished prior to installing the new carrier engine.

- (a) Functionally test after it is installed on vehicle. The vehicle's engine would be run for a total of 50 hours. During this time, the engine speed would be cycled from 1000 to 1800 RPM every 15 minutes, and the vehicle's air system pressure would be bled down to 60 psig every 10 minutes. After testing, the old compressor would be reinstalled. The new compressor modifications and parts would be inspected for damage or excessive wear.

The estimated cost for this item, including testing at VSE, is \$36,000 and is based on performing the initial investigation study at Fort Pickett, VA. A reduction in the estimated cost of \$960 is possible if the study is performed at VSE.

Recommendations:

- o Perform an investigative study to determine if adaption of air compressor P/N 3018532 is possible.
- o Design modifications to retrofit the Cummins V903 engine air compressor to the obsolete Cummins V8-265 engine.
- o Implement the design by fabricating, installing, and testing a prototype compressor and engine assembly.

4.6 M2385 and M320 RT Crane Common Parts

4.6.1 NSN 2910-00-438-1487; Fuel Tank for the Models M2385 and M320 RT Crane Carrier engines (Dwg. 97403-13213E9498).

This tank is a semi-custom item manufactured by Snyder Tank Corporation. Snyder builds tanks to-order but does not stock assembled tanks. However, they do stock the standard tank parts (formed ends, baffles, fill tubes, etc.) from which this tank can still be built. Being a semi-custom builder, Snyder would prefer an order of 50 tanks (10 tanks minimum) to warrant setting up their normal production run method of manufacture. However,

Snyder will accept orders for just one tank. For orders less than 10, they likely would subcontract fabrication to a shop next door, Skrole Iron and Welding. Unit cost would depend on the quantity ordered.

The Government drawing specifies Snyder P/N 6253, but this part was never built. The Government's MCRL specifies Snyder P/N 6174 for this tank, and Snyder has built the P/N 6174 tank.

VSE has not been able to locate an equivalent alternate fuel tank fabricator.

Recommendation:

- o Take no further action because fuel tank P/N 6174 is valid and still available from Snyder.

4.6.2 NSN 2520-00-404-2713. Torque Converter for the Models M2385 and M320 RT Crane Carriers (Dwg. 97403-13205E3354).

This converter is still available from the manufacturer, Clark Equipment Company (Government Sales Office) P/N 282473.

A Twin Disc Inc. Model 8FLW-1450 converter could be used as an alternate. Installation will require plumbing changes to the three hydraulic pumps mounted on the converter. Development of a retrofit kit and MWO will be necessary.

Recommendation:

- o Take no further action because converter P/N 282473 is still available from Clark Equipment Company.

4.6.3 NSN 2520-00-404-2693; Transmission for the Models M2385 and M320 RT Crane Carriers (Dwg. 97403-13205E3357).

This transmission, manufactured by Clark Equipment Company (P/N 282472), is obsolete and superseded by P/N 289746. According to Clark, the new part is 100 percent interchangeable with the old part.

A Twin Disc, Inc., Model TD-44-1130 Transmission could be used as an alternate item. Dana Corporation was contacted but has nothing large enough.

Installation of the Twin Disc transmission requires new transmission mounting brackets, as well as new input and output drive shafts. Additionally, the transmission shift control will need to be changed from Clark's hydraulic type to a Twin Disc electric type. Plumbing changes will also be necessary for lines connecting to the new transmission. Development of a retrofit kit and MWO will be necessary.

Recommendation:

- o Take no further action because the Clark transmission P/N 289746 is completely interchangeable with the older transmission P/N 282472.

4.6.4 NSN 4320-00-404-2708; Hydraulic Motor for the Models M2385 and M320 RT Crane Carriers (Dwg. 97403-13213E9580).

This Trinova Corporation/Vickers Inc. motor (P/N 25M35A3C20A125) was identified as being no longer available. The threaded end of the shaft was identified by Vickers as the obsolete part, but the remainder of the motor itself is still available. Vickers engineering personnel later informed VSE that the special shaft was still available and that the motor was available per the original NSN and P/N.

Recommendation:

- o Take no further action because the hydraulic motor, Trinova/Vickers P/N 25M35A3C20A125, is still available.

4.6.5 NSN 2590-00-245-7673; Hydraulic Dozer Cylinder for the Models M2385 and M320 RT Crane Carriers (Dwg. 97403-13205E3536).

Cascade Corporation (P/N 4CX9765) has no record of ever building this cylinder and referred us to their dealer (AWD in Westfield, OH). The dealer, in turn, further directed us to Seitz Mfg. Co., Inc., who is most likely to have built them originally. The last Government procurement, in 1970, was for 32 cylinders costing \$178 each.

Seitz furnished a quote to make the cylinder (\$335.00 each for quantities from 10 to 24, and \$312.00 each for 25 or more). Of the five other cylinder manufacturers contacted, only M&M Hydraulic Company has quoted (\$751.55 each for quantities 1 to 7, \$701.45 each for quantities 8 to 15, and \$657.61 for quantities 16 to 35).

Because the new cylinder would be a direct replacement, an MWO would not be required. However, the present Government drawing (97403-132053536) will require revision to delete Cascade and add the new vendor source.

The dozer cylinder on the M2380 Crane Carrier is the same as this cylinder with the exception of having different type ports. The same new cylinder can be retrofitted into the M2380 by simply changing the two connecting hydraulic hoses.

A Model M2385 dozer cylinder direct replacement could be procured, installed and the vehicle tested (see The Appendix). After testing, the old cylinder would be reinstalled. The

estimated cost of \$3,000 for this item is based on accomplishing the M2385 Front Axle Retrofit at the same time.

Recommendations:

- o Procure a Hydraulic Dozer Cylinder from Seitz, install it on the vehicle, and test.
- o Upon the successful completion of testing revise Government drawing 97403-132053536 to delete Cascade and add Seitz as the new vendor source.

4.7 Parts Common To All Three Model Cranes

4.7.1 NSN 2520-00-404-2710; Front Axle for the Models M2385 and M320 RT Crane Carriers (Dwg. 97403-13213E9493-2).

This Clark Equipment Company axle (P/N FDS 29500-1) has been obsolete since 1976. The last Government procurement, during 1971, was for two axles costing \$7,146 each. Both front and rear axles on all three model crane carriers are obsolete, not just the one cited.

The Model M2380 Crane Carrier's front and rear axles are interchangeable with those on the M2385 and M320 RT Crane Carriers, though some differences exist. Their overall gear ratios (19.078 to 1) are identical, as are all interface features.

Rockwell International, as a second source, had developed axles (Dwgs. 97403-13213E9408 and -13213E9394) for the Models M2385 and M320 RT Crane Carriers. However, these axles were never procured while the crane was in production and are no longer available.

Possible replacements are:

- a) Clark Model 16S1841 has the same overall gear ratio (19.078 to 1) and is suitable for the loading. This new axle will cost about \$16,000 each for a quantity buy of 40 axles (about \$21,000 for a buy of one).
- b) Rockwell Model PSC-1614 is suitable for the loading and they can furnish an overall gear ratio that is near the 19.078 to 1 ratio. Actual existing gear ratio and budget costs have not yet been received. Both front and rear axles must be Rockwell due to the difference in gear ratios.

Installation of either selected new axle will require axle modifications (input shaft drop box added, axle mounting pad changes, and steer cylinder inboard mounts relocated), retrofit changes to the mating wheel rims, and a possible length change to

the mating drive shaft. Development of a retrofit kit and MWO will be necessary.

Recommendations:

- o Obtain the Clark Model 16S1841 axle and perform the required modifications.
- o Install the modified axle and test the crane (see The Appendix).
- o Develop a retrofit kit and prepare an MWO.

4.7.2 NSN 4820-01-164-3415; Emergency Relay Valve for the Models M2380, M2385 and M320 RT Crane Carriers (MS530004-1).

The MS530004-1 valve was available from two sources, Bendix Heavy Vehicles Systems Division of Allied Signal (P/N 7004-26) and Midland Heavy Duty Systems (P/N N4171L), but it is now obsolete. Bendix's replacement is P/N 281860, and Midland's replacement is P/N N4301. Both companies said the replacements are functionally interchangeable but some interface differences may exist depending on the specific installations involved.

It is not necessary to check valve installation on the Model M320 RT because its air system is the same as the Model M2385. Development of a retrofit kit and MWO may be necessary.

Recommendations:

- o Try both vendor valves on both the Model M2380 and M2385 Crane Carriers to see if interchangeability exists.
- o Test the valves (see The Appendix).

4.7.3 NSN 4320-00-401-7133; Hydraulic Dual Pump for the Models M2385 and M320 RT Crane Carriers (Dwg. 97403-13213E9486).

A discrepancy exists between the Vickers model numbers on Drawing 97403-13213E9486 and the MCRL for the same NSN. The model number and dimensions on Drawing 97403-13213E9486 are for Vickers No. 3525V25E17-13CC10L, whereas the MCRL NSN and characteristics listed on Drawing 97403-13213E9486 are for Vickers No. 3520V25E14-13CC10L. Both of the pumps are available from Vickers, however their model numbers have changed:

- o Vickers Model No. 3525V25E17-13CC10L is now 3525VQ25E17-11CC20L.
- o Vickers Model No. 3520V25E14-13CC10L is now 3520VQ25E14-11CC20L.

There are no physical changes between the old and new model numbers.

Recommendations:

- o Resolve the discrepancy between model numbers and identify the model used during production.
- o Correct the Technical Data Package (TDP) with the correct pump model number.
- o Take no further action because the pump is still available from Vickers.

4.8 M320 RT Crane Carrier Engine. During our data review we noted that the M320 RT Crane Carrier is powered by the Cummins V903 engine. Although the V903 is available, its cost of \$26,000 is more than four times that of the Caterpillar Model 3116 engine. Service-wise, the Caterpillar Model 3116 engine appears to be a suitable replacement for the Cummins V903 if/when an engine replacement is required.

Recommendation:

- o TACOM should consider using the Caterpillar Model 3116 engine as a replacement for the M320 RT Crane Carrier's Cummins V903 engine.

5. CONCLUSION

- o Discrepancies between old and new manufacturer's end item data needs to be identified and corrected in TACOM selected TDPs and other provisioning documentation.

6. RECOMMENDATIONS

- o TACOM should correct selected end item TDPs before using them for competitive procurement actions.
- o TACOM should correct all provisioning documentation for selected end items.

THE APPENDIX

TESTING. Testing of the Model M2385 Crane would be performed after completing installations of replacement items discussed in sections 4.3.1, 4.5.1, 4.6.5, 4.7.1, and 4.7.2.

The Government would be required to provide a crane (upper works) operator, crane lifting loads, and suitable test sites at or near Fort Belvoir, VA. The estimated cost to perform testing is \$41,000.

TEST PLAN AND TEST REPORT. A test plan for each test will be prepared according to the requirements of Belvoir Contract DAAK70-90-D-0001, Data Item No. A071. A Test and Demonstration Report will be prepared, according to Data Item No. A028 after all tests are completed. The estimated cost for these items is \$14,000.

A test schedule is shown on the next page.

20 TON ROUGH TERRAIN CRANE VEHICLE TESTING

TEST SCHEDULE		
TEST NO.	TEST TITLE	MIL-C-52341 TEST PARAGRAPH
1.	SOUND LEVEL	4.6.2.37
2.	WATER FORDING - ONE 4 HR CYCLE ONLY, SEE NOTE (1)	4.6.2.8
3.	GRADABILITY - CLIMB UP 40% SLOPE ONLY, SEE NOTE (1)	4.6.2.34
4.	1000 MILE ROADABILITY	4.6.2.9.1
5.	SERVICE BRAKES	4.6.2.22.1
6.	FAIL - SAFE BRAKES	4.6.2.22.3
7.	EMERGENCY BRAKES	4.6.2.22.2
8.	LIFTING STABILITY - WITH 60 FT BOOM AT MAX RADII ONLY, SEE NOTES (1) & (2)	4.6.2.11
9.	60 FOOT BOOM AND JIB HOISTING - SEE NOTE (2)	4.6.2.11.4
10.	CRANING - 50 HOURS,SEE NOTES (1),(2) & (3)	4.6.2.11.5

NOTES:

- (1) Test limited to that specified.
- (2) Government shall provide upper works crane operator and test loads.
- (3) Only with outriggers and only with load condition resulting in greatest engine load.